O3b – A different approach to Ka-band satellite system design and spectrum sharing

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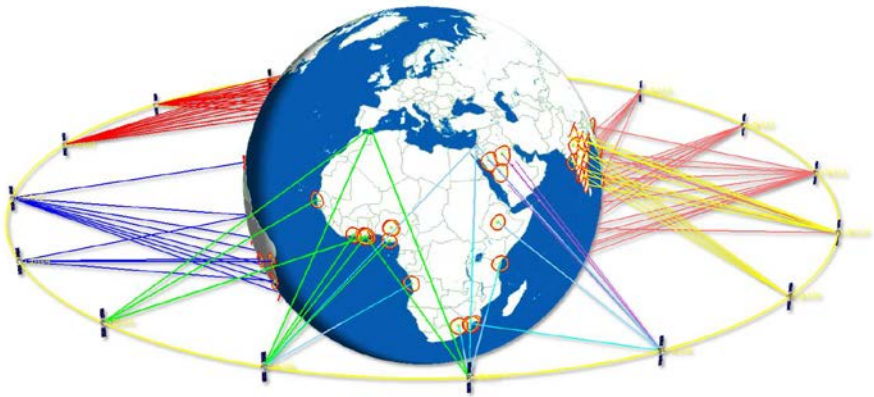
O3b's Non-Geostationary Satellite/Constellation Design

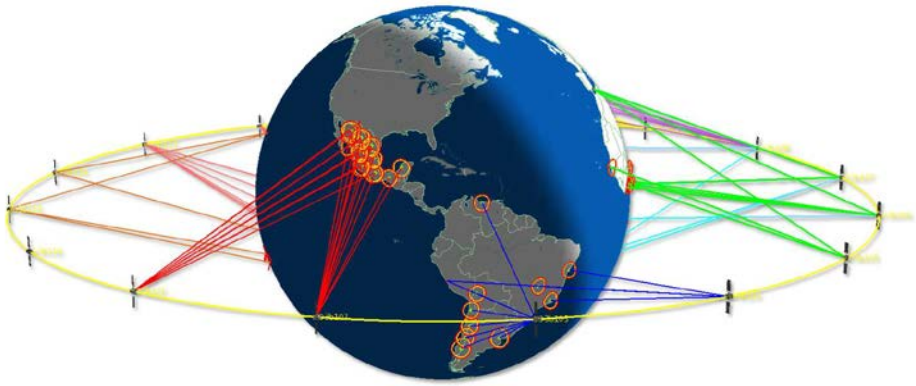
- Circular equatorial orbit at 8,062 km altitude
- 288 minute orbit period
- 8 satellites in initial launch in early 2013
- Launch 4 more satellites soon after
- Inherent in-orbit redundancy
- 10 years minimum life time
- 12 steerable spot beam antennas on each satellite

Comparison of the O3b Orbit with the GSO

- 4.8 times closer to Earth than the GSO (8,062 km orbit altitude)
  - lower launch costs, multiple satellites per launch vehicle
- 13dB Path Loss reduction relative to GSO
  - link budget improvement
- 20 times lower power requirement than GSO based on reduced Path Loss
  - smaller satellites, less weight for solar panels, batteries, etc.
- Less than 150 ms latency (round-trip)
  - more communications services and applications are possible
- Uses tracking earth stations
  - Suited to certain types of fixed applications and all mobile ones
  - Electronically steerable antennas under development

O3b's Communications Concept





- Steerable Ka-band spot beams
- Seamless handover between satellites
- Bent-pipe connecting gateways with customers for internet access
- 2 beams per satellite for gateways
- 10 beams per satellite for customers
- Customers use:
  - medium/large ES only for high capacity fixed links
  - Medium/small ES for mobile applications
- Beam coverage: ~700 km diameter
- Channel bandwidth: 216 MHz
- Coverage ~45 N° N/S latitude

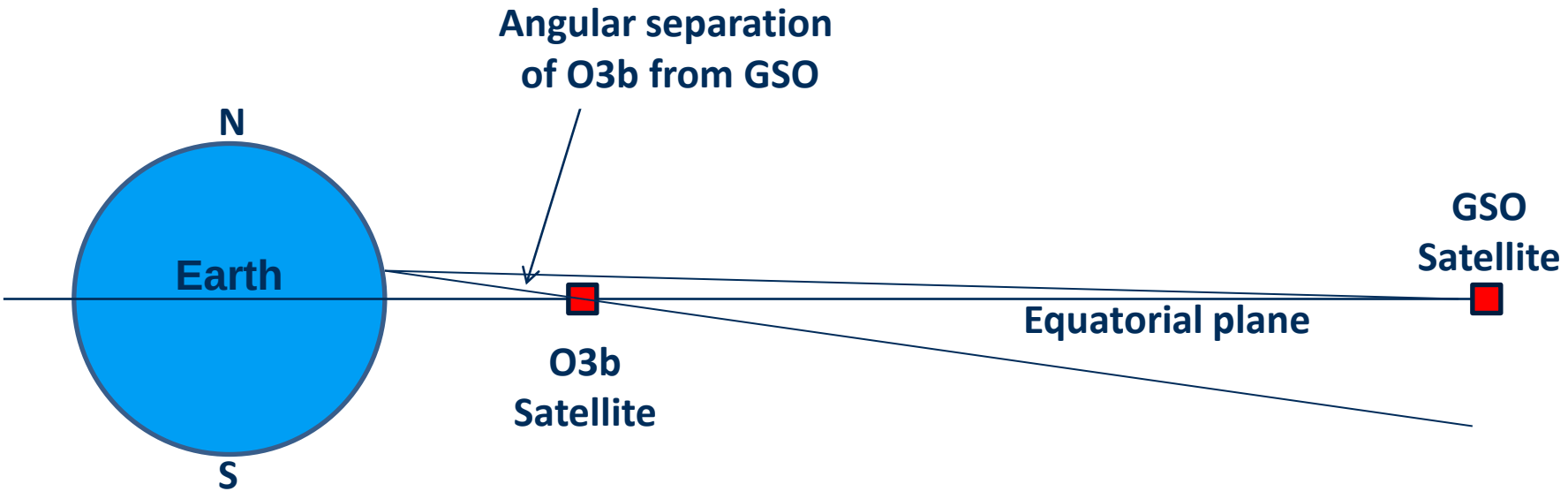
Coverage Capability of the O3b Orbit
(showing planned O3b Gateways)

O3b Networks
Fiber Speed. Satellite Reach.

Customers can connect to fiber infrastructure through Regional Gateways

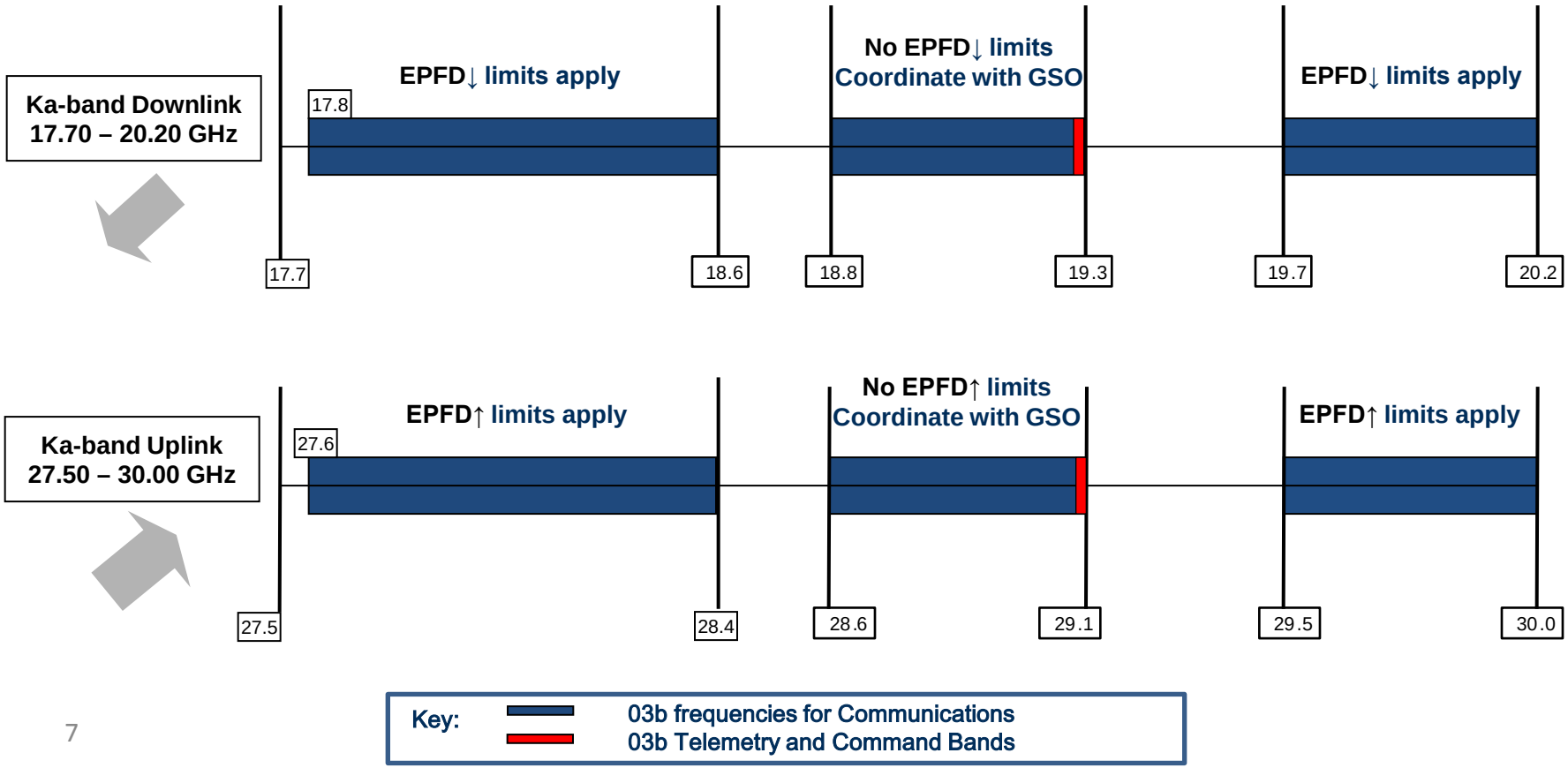
Global Coverage anywhere 45˚ North/South of the equator
Some gateway locations still being evaluated.

Inherent Angular Separation of O3b Orbit from GSO



- Interference potential exists with GSO only in narrow range of equatorial latitudes (e.g., within approx. 5˚ of the equator)

O3b Frequency Plan



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O3b Spectral Efficiency

- Dual polarization:
  - Full frequency re-use achieved by dual orthogonal polarization for both gateway beams and customer beams
- Spatial frequency re-use:
  - Additional spatial frequency re-use between gateway beams and customer beams
- Total frequency re-use factor is therefore 4 times

O3b Sharing with GSOs (1 of 2)

- O3b does not use the following portions of Ka-band:
  - 200 MHz bands of 18.6-18.8 GHz down and 28.4-28.6 GHz up (downlink not available to O3b type orbit – see 5.522B)
  - 400 MHz bands of 19.3-19.7 GHz down and 29.1-29.5 GHz up (MSS/NGSO feeder link allocation – see 5.523B and 5.535A)

- In the parts of Ka-band where EPFD limits apply and in situations where interference could occur with respect to GSO satellite networks, O3b will not use the spectrum
  - e.g., for service to geographic locations close to the equator
  - consists of 1,400 MHz of spectrum on uplink and same on downlink

- O3b only needs to coordinate with GSOs based on ITU date priority in the 500 MHz segments of Ka-band that are allocated by the ITU with equal rights to GSO and non-GSO (i.e., 18.8-19.3 GHz down and 28.6-29.1 GHz)

O3b Sharing with GSOs (2 of 2)

- O3b coordination with GSOs is limited to 20% of the normal “commercial” Ka-band spectrum available to GSOs
  - or 14.3% if the GSO has access to the “government” portion of Ka-band (20.2-21.2 GHz down and 30.0-31.0 GHz up)
- All real-world broadband Ka-band satellites require a relatively large amount of spectrum for Gateway links
  - e.g., KA-SAT uses 2,000 MHz of spectrum for Gateways and 500 MHz for Users to limit the number of Gateway locations
- Regional broadband Ka-band satellite networks are less likely to use Gateways in equatorial regions because of rain-fade and fibre interconnectivity reasons
- Conclusion:
  - O3b shares well with GSOs that use the 18.8-19.3 GHz and 28.6-29.1 GHz bands not located in equatorial regions, such as for Gateways

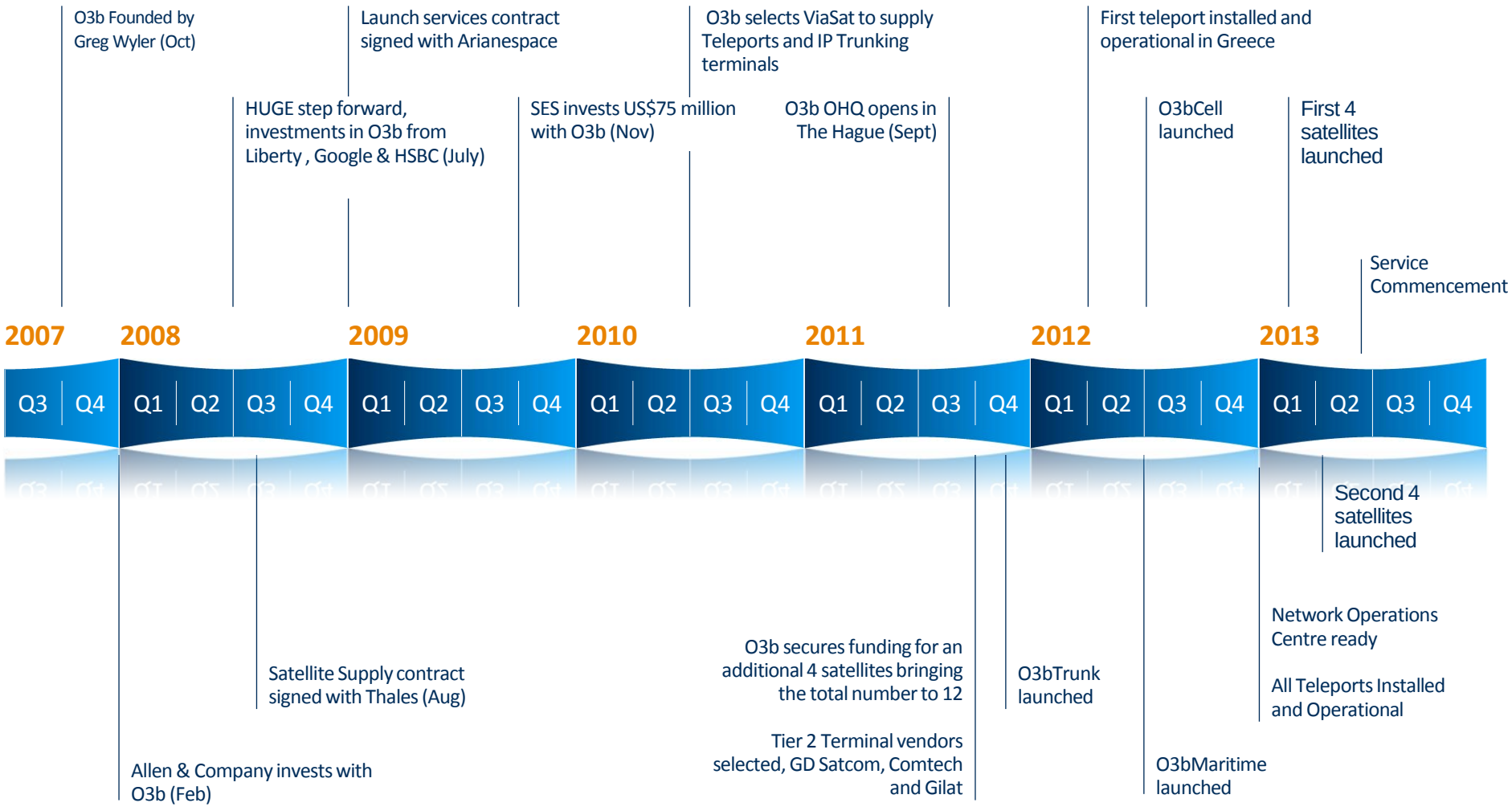
O3b Sharing with NGSOs

- O3b shares well with certain other types of NGSO satellite systems where angular separation between the orbits can be maintained

- Russian Molniya is a perfect example:
  - O3b orbit appears in a different part of the sky from the active arc of the Molniya orbit

- Similar compatibility exists with other HEO (Highly Elliptical Orbit) systems, as studied by the Working Parties of the ITU

O3b's Progress and Launch/Operation Schedule

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